EFFECT OF ICT INTEGRATED ETHNOMATHEMATICAL TEACHING ON METACOGNITIVE SKILLS, NUMERICAL ABILITY, PROBLEM SOLVING ABILITY AND CREATIVITY AMONG SECONDARY STUDENTS

A

Synopsis

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1.0.0 INTRODUCTION

Education is a revolutionary instrument to bring about desirable behavioural changes in the students leading to the all round development of the personality. Education is such a tool which helps one to differentiate right and wrong. It promotes one in all dimensions such as intellectual, physical, social, emotional and spiritual aspects. Education is the provider of a good life, wealth, power and respect. Thus education is most important for every human being. There the need of schools comes, which helps small children to foster their knowledge by being at one place. The well being of the children depends on the key role of the schools and its educational transactions. The best way of transaction of knowledge is done with the help of best curriculum. School curriculum plays a vital role in drawing out the innate capacities of the child. So that he/she can be motivated for gaining new knowledge and attaining vocational stability.

Mathematics is one of the important subjects in school curriculum. This is called as the "Queen of Sciences". It is well observed practically that those who are good in Mathematics could do better in every other subject. One of the recommendations of Kothari Commission Report (1966), was "Science and Mathematics must be an integral part of school education in the first ten years to age 16+ (class X)"

Mathematics is an important school subject taught right from the kindergarten level, across most of the contemporary cultures. It is one of the least understood subject and not many people feel comfortable with it. It is often taught and perceived as a subject that is completely detached from the real world. According to NPE 1986, Mathematics should be visualized as the vehicle to train a child to think, reason, analyze and to articulate logically. Apart from being a specific subject, it should be treated as a concomitant to any subject involving analysis and reasoning.

NCF 2005 also emphasizes that Quality access of Mathematics Education is the right of every child. It also stress that the Mathematical skills developed in the primary level are useful, but aiming for higher skills at secondary level to be achieved with the proper provision of Mathematical

education with the help of connecting the curriculum with their real life situations and Visualization and representation skills are to be developed in Mathematics.

NCF 2005 states that "When a farmer estimates the yield of a particular crop, he uses considerable skills in estimation, approximation and optimization. School Mathematics can play a significant role in developing such useful skills. ……. Individual and group exploration of connections and patterns, visualisation and generalisation, and making and proving conjectures are important at this stage, and can be encouraged through the use of appropriate tools that include concrete models as in Mathematics laboratories and computers".

Before implementing all such plans, it is must to know the present scenario of India, to get to know the recent trends and practices carried out in present school situations. According to NCERT, 2006 Report, "School Mathematics takes place in a situation where: (1) Children learn to enjoy Mathematics, (2) Children learn important Mathematics, (3) Mathematics is a part of children's life experience which they talk about, (4) Children pose and solve meaningful problems, (5) Children use abstractions to perceive relationships and structure, (6) Children understand the basic structure of Mathematics and (7) Teachers expect to engage every child in class." Even though the status of Mathematics Education has been improved, the quality of it is not yet increased, which is the urgent need of school curriculum today.

If we go through the research studies and reports, the results revealed that the quality of Mathematics Education is not up to the International standards. There are many reasons behind the low achievement in Mathematics Education at school level in India. The students at every level of system of education feel that it is an alien subject, which is created by great brains. They consider it as a subject of higher difficulty level. They lack interest in Mathematics learning because of the fear about the subject, the failure rate in exams, lack of activities, boredom in classrooms due to ineffective curriculum transactions, no special provisions for the talented students in a normal classroom setup, lack of trained teachers, incapable evaluation system, etc.,.

The secondary level curriculum should aim for the students to get increase their competencies towards enter life. Mathematics should focus on 'problem-solving' including a variety of 'real-life' situations. This could be done with the help of teaching and learning through modern techniques such as usage of audio, video clips, computer-aided instruction and other information and communication technological tools. The curriculum should help every student to get fluency in the basic and fundamental concepts and knowledge of the subject and thus should be helpful in the development of higher order mental processes of logical reasoning. The teacher should help the students to develop a 'love' for the subject and an appreciation of its power and its limitations, and participate in all Mathematical activities like contests, competitions, talent searches and Olympiads which are organized at local regional and national levels. The concept of creativity is also to be developed among the students in such a way that they would be able to understand the concepts of Mathematics easily and also able to comprehend it in their own way/approach.

The Mathematics curriculum at the upper primary stage should be correlated to their day-to-day life activities and needs. Mathematics learning at this stage should take place through 'doing' and transactional materials should integrate this feature. Wherever there is a possibility, the related social and cultural aspects of Mathematics should be accentuated. The applications of Mathematics should be from real-life, for instance, from industry, trade, agriculture, or commerce so that the student becomes aware about the developments of the country.

There are rigorous efforts underway in the country to make education more relevant to its people, more rooted in its ethos, more reflective of its heritage and more anticipative of the coming century. 'Reform' in Mathematics curricula appears to have gained momentum both at the state and national level through the efforts of governmental as well as non-government organizations and agencies and also the Examination Boards.

Mathematics is a language which is not dropped out from heaven directly to the Earth. It was discussed and dealt in everyday life by every person who runs a life. All Mathematical concepts got evolved from the daily life situations long years back. Every culture has its own credit

in the Evolution of Mathematics. Researchers, focuses on the roles of religion and language of instruction in Mathematics in as far as the two factors operate as cultural carriers or cultural barriers in Mathematics Education. Claudia Zaslavsky (2003), USA, emphasizes the necessity for the expansion of the curriculum at any level to include culturally specific Mathematical practices as social practices in daily life ("Ethnomathematics") and presents possibilities for doing so in the elementary and middle grades. Such a rich diversity between cultures, and therefore within Mathematics as a whole, can considerably enrich the quality of Mathematical activities in different classrooms around the world.

It is recognition of hidden Mathematics in the culture, a regard for local workmanship and craft, it is trustworthy, it is practically applicable, it is integrated in life situations, it is more beneficial. There a question arises. Why is it that important for school Mathematics? The reasons behind it are as follows:

- As it is a part of one's culture, it will remove the fear about the subject Mathematics.
- As the concepts are building upon the people's daily routines, it will give better understanding of the concepts.
- It will help to develop skills related to life easily
- It will be more familiar rather than seems to be alien
- As it is practiced provides "the essence of building up a body of knowledge in a Mathematical sense" (D'Ambrosio, 1984, p. 5-6).
- It will create interest in Mathematics learning
- It will help to develop the abilities in Mathematics
- It will lead the students to be creative while planning, applying strategies, in expression, in evaluating, in evolving new concepts.

In the present day situation, the dominant type of Mathematics learned and taught in school is useless and meaningless to most of the students in the world. It is must to develop confidence in

people, the Mathematics Education is not that tough as everyone assumes. To win (cultural) self-confidence, it is important to prove the students that Mathematics is not alien to their home culture that Mathematics does not come from outside their culture.

India is such a cultural rich country and it is a great regret that we are not using such enriched culture, by integrating it in the real curriculum. In reality no school is following the concept of Ethnomathematical teaching. The main reason for the gap between the curriculum and the lives it should enrich is that the educational system transported to India by its colonial master was not adapted to the socio-cultural context of the subcontinent. The development of schools and institutions was conceived within the British system, not a regional one (Smith 2000; Gates & Vistro-Yu, 2003; Rampal, 2003). When we are lagging in Mathematics Education in the achievement to the International standards, it is time to think over and implement such efficient teaching ideas and strategies to express the Mathematical concepts embedded in our own culture, which will bring out the desirable success towards Mathematics Education not only quantitatively also qualitatively.

The National Policy on Education - 1986 (Article 8.17), envisages redesigning the teaching of Mathematics to incorporate changes in technology and introduction of computers in schools. When Ethnomathmatics alone can do magic in Mathematics Education, then the integration of ICT can do miracles.

1.1.0 EMERGENCE AND JUSTIFICATION OF THE PROBLEM

The Mathematics knowledge found in a culturally relevant pedagogy is perceived as a version of Ethnomathematics because *ethno* is defined as culturally identifiable groups with their beliefs, codes, symbols, myths, and even specific ways of reasoning and inferring; *mathema* is defined as categories of analysis; and *tics* is defined as methods or techniques for solving problems faced daily. In a culturally relevant Mathematics classroom, teachers build from students' previous knowledge (*ethno*) and direct the lessons toward their culture and experiences (*mathema*) while

developing critical thinking skills (*tics*) (Rosa, 2010). The secrete behind the Japanese's and Chinese's success in Mathematics, science and technology today is traceable to their use of Ethnomathematics (Tereziaha, 1999; Obodo, 2000; Kurumeh, 2004; Uloko and Imoko, 2007).

In relation to the pedagogical work in schools, Mathematical curricular activities must be relevant to the students' cultural backgrounds. The views of pedagogy within the literature on Ethnomathematics are compatible with work on culturally relevant pedagogies (Hart, 2003) because they examine the cultural congruencies between the community and school. This is one of the important principles of Ethnomathematics. This means that cultural congruence indicates the teachers' respect for social, cultural, and linguistic backgrounds of their students. However, it is equally necessary that school leadership and teachers acquire the knowledge of and respect for the various cultural traditions, languages, and Mathematical knowledge of their students so they are able to implement the principle of cultural congruence in schools and classrooms (D'Ambrosio, 1990). On the other hand, since Mathematics usually tends to be presented as a set of objective and universal facts and rules, it is viewed as *culture free* and not considered a socially and culturally constructed discipline.

To change this perception, it is necessary that curriculum developers and teachers take into account what counts as Mathematics and how this knowledge itself may be related to the norms and values of diverse cultures (Rosa, 2010). If as educators we come to integrate the diverse cultures we encounter in our school communities, then there is a need to create a conceptual framework to make coherent decisions regarding these curricular activities concerning the Mathematics curriculum.

It is obvious that the Ethnomathematical perspective, where-in the embeddedness of Mathematics in all cultures takes on the cultural nature of knowledge production into a Mathematics curriculum. It may be confined that culturally relevant pedagogies may be considered as an Ethnomathematical approach to the development of a Mathematics curriculum because they intend to make school

Mathematics relevant and meaningful regarding the promotion of the overall quality of students' educational experience.

It is necessary to integrate a culturally relevant pedagogy into the existing Mathematics curriculum because it proposes that teachers contextualize Mathematics learning by relating Mathematical content to students' real life-experiences. The importance of building connections between Mathematics and personal lives and cultures of students is as important as transaction of knowledge. Along with this line, when practical or culturally-based problems are examined in a proper social context, the practical Mathematics of social groups is not trivial because they reflect themes that are profoundly linked to the daily lives of students (Rosa & Orey, 2007). In this perspective, students may be successful in Mathematics when their understanding of it is linked to meaningful cultural referents, and when the instruction assumes that all students are capable of mastering the subject matter such as Mathematics.

Curricular activities developed according to principles of culturally relevant pedagogy focus on the role of Mathematics in sociocultural contexts that involve ideas and procedures associated with Ethnomathematical perspectives to solve problems. The Mathematics knowledge found in a culturally relevant pedagogy is perceived as a version of Ethnomathematics because *ethno* is defined as culturally identifiable groups with their jargons, codes, symbols, myths, and even specific ways of reasoning and inferring; *mathema* is defined as categories of analysis; and *tics* is defined as methods or techniques for solving problems faced daily. In a culturally relevant Mathematics classroom, teachers build from students' previous knowledge (*ethno*) and direct the lessons toward their culture and experiences (*mathema*) while developing critical thinking skills (*tics*) (Rosa, 2010).

The inclusion of cultural aspects in a Mathematics curriculum has long-term benefits for students' Mathematical attainment because these aspects contribute to recognizing that Mathematics is part of our daily lives and deepen the understanding of its nature by enhancing students' ability to make meaningful connections. Thus, pedagogical work towards an Ethnomathematics perspective

allows for a broader analysis of school contexts in which pedagogical practices transcend classroom environments (Rosa, 2010). Therefore, Ethnomathematics presents possibilities for educational initiatives and new curriculum objectives because it is a research program that guides educational pedagogical practices. However, the incorporation of the objectives of a pedagogical action of an Ethnomathematics program is a recent field of study that is developing its own identity in Mathematics Education (Rosa & Orey, 2007). Thus, a dilemma regarding this issue is how to prepare teachers to elaborate curriculum activities based on culturally relevant pedagogy and Ethnomathematics (Greer, 2013).

The trend towards Ethnomathematical approaches in Mathematics curriculum development and culturally relevant pedagogy initiatives reflect a comprehensive development in Mathematics Education. Ethnomathematical approaches are intended to make school Mathematics more relevant and meaningful to students in order to promote the overall quality of education; and to plead for more culturally relevant views of Mathematics. For example, it is important to elaborate Mathematics curricula that are based on the previous knowledge of students, and which allows teachers to have more freedom and creativity. In this context, it is necessary that teachers value the diverse home cultures of students by explicitly addressing curricular connections to the previous knowledge they bring to school. In this approach, teachers need to teach Mathematics in a culturally appropriate manner situated within students' funds of knowledge in order to underscore connections to their home culture and use them to scaffold learning.

The application of culturally relevant pedagogy and Ethnomathematical perspectives in classroom validates and incorporates students' cultural background, ethnic history, and current societal interests into teachers' daily instruction. It addresses students' socio-emotional needs and uses ethnically and culturally diverse materials for its pedagogical action in classrooms (Gay, 2000). In this regard, culturally relevant pedagogy is an educational approach that empowers students intellectually, socially, emotionally, and politically through the use of socio-cultural and historical references to convey knowledge, imparts academic skills, and change students' attitudes

towards academic instruction. This pedagogical approach is achieved through dialogue when community members, teachers, and students discuss Mathematical themes that help them to reflect about problems that are directly relevant to their community. In this context, students investigate conceptions, traditions, and Mathematical practices developed by members of distinct cultural groups in order to incorporate them into the Mathematics curriculum. Teachers learn to engage students in critical analysis of the dominant culture as well as the analysis of their own culture.

The use of culturally relevant pedagogy values the previous knowledge of the members of a given cultural group such as former slaves by developing the process of elaborating Mathematical procedures in its different contexts such as political, social, economic, and environmental. In this regard, the Mathematics practiced and elaborated by the members of distinct cultural groups, and involves the Mathematical practices that are present in diverse situations in the daily lives of members of these diverse groups. Mathematizing ideas involves connecting the informal Mathematics developed in a given cultural group to formal Mathematical concepts by using ideas, procedures, and Mathematical practices that are used by the member of specific cultural groups.

It important to emphasize that this kind of curriculum may motivate some students to recognize Mathematics as part of their everyday life and can enhance students' ability to make meaningful Mathematical connections by deepening their understanding of all forms of Mathematics. The objective of developing an Ethnomathematical curriculum model for classrooms is to assist students to become aware of how people mathematize and think mathematically in their culture, to use this awareness to learn about formal Mathematics, and to increase their ability to mathematize in any context in the future. This kind of curriculum leads to the development of a sequence of instructional cultural activities that enable students to become aware of potential practices in the Mathematics in their culture so that they are able to understand the nature, development, and origins of academic Mathematics. Students also value and appreciate their previous Mathematical knowledge, which allows them to understand and experience these cultural activities from a Mathematical point of view, thereby, allowing them to make the link between

school Mathematics and the real world. An Ethnomathematical curriculum helps students understand the nature of Mathematics because it presents us an effective tool that can contribute the learning of Mathematics of students (Rosa & Orey, 2007).

The integration of Ethnomathematics and culturally relevant pedagogy into the Mathematics curriculum focuses on the development of this research area as a process, rather than a collection of facts because it is based on the idea that Mathematics is a human creation that emerges as people attempt to understand and comprehend the world around them. Therefore, Mathematics can be seen as a process as well as a human activity rather than just as a set of academic content (Rosa, 2010). The implication of this kind of curriculum is not just about the application of relevant contexts in learning and teaching Mathematics, but is also about generating formal Mathematics from cultural ideas. Mathematics knowledge in the context of culturally relevant pedagogy can be perceived as an Ethnomathematical perspective because teachers build from the students' informal Mathematics and orients the lesson toward their culture and experiences, while developing their critical thinking skills. In this context, students are considered as a culturally identifiable group with their own jargons, codes, symbols, myths, and specific ways of reasoning and inferring (ethno) who develop their own categories of analysis (mathema) and apply specific methods or techniques to solve problems faced daily.

Since Ethnomathematics studies the cultural aspects of Mathematics and presents the Mathematical ideas, procedures, and practices of the curriculum in a way that is related to student cultural backgrounds by enhancing their ability to make meaningful connections and deepening their understanding of Mathematics. This perspective matches teaching styles to the culture and home backgrounds of their students, which is one of the most important principles of culturally relevant pedagogy. Teaching Mathematics through cultural relevant and Ethnomathematical perspective helps students to know more about reality, culture, society, environmental issues, and see Mathematics in the world around them. By providing students with Mathematical content and approaches that enable them to successfully master academic Mathematics, an Ethnomathematical

approach to the Mathematics curriculum is considered a pedagogical vehicle for achieving such a goal.

The studies related to Ethnomathematics are tabled below:

Table no 1.1: Table depicting Researches on Ethnomathematics

Researcher	Year	Title of the study	Results
Unodiaku, Stanislus Sochima	2013	Effect of Ethno-Mathematics Teaching Materials on Students' Achievement in Mathematics in Enugu State (Nigeria)	Ethno-mathematic achievement test was effective in enhancing students' achievement in mensuration with particular reference to volumes of cylinder and hemisphere.
Iluno, C., Taylor, J.I	2013	Ethnomathematics: The Key to Optimizing Learning and Teaching of Mathematics	The students exposed to ETA performed highly than those taught with convectional teaching approach (CTA).
Kurumeh M.S., et.al.,	2012	Improving Students' Retention in Junior Secondary School Statistics Using the Ethno-Mathematics Teaching Approach in Obi and Oju Local Government Areas of Benue State, Nigeria	The Ethnomathematics teaching approach was more effective in facilitating and improving students' retention in statistics than the conventional approach.
Davidson, D.M.	2012	An Ethno-Mathematics Approach to Teaching Language Minority Students.	Ethno-mathematics Approach was very effective to improve the language skills of the minority students.
Weizhong Zhang, Qinqiong Zhang	2010	Ethnomathematics and its Integration Within the Mathematics Curriculum	Integrating materials from different cultures into the curriculum, and then making correct evaluations of all students

			with different cultural backgrounds helped in enhancing everyone's confidence and learning to respect all ethnic groups and Cultures.
Emmanuel E. Achor et.al.,	2009	Effect of Ethnomathematics Teaching Approach on Senior Secondary Students' Achievement and Retention in Locus	The students exposed to ETA were superior in achievement and retention than those taught with conventional approach.

Based on the International research evidences most of the researches on Ethnomathematical Teaching are concentrated on Academic Achievement, retention, language learning, learning, locus of control and curriculum and of different regions or countries of the world. Literature search revealed insufficient research reports on the use of concrete teaching materials such as Ethnomathematics teaching materials in teaching Mathematics concepts (Ozofor, 2001; Unodiaku, 2012; NCTM, 2013). The researcher has not come across any national study on Ethnomathematics.

It is nowadays widely accepted that Metacognitive knowledge and skills influence Mathematical problem solving (e.g., Borkowski, Chan, & Muthukrishna, 2000). Metacognition refers to the ability of individuals to be aware of and monitor their learning processes. Metacognition has traditionally been differentiated into two central components, namely Metacognitive knowledge and Metacognitive skills. In young children a combination of prediction and evaluation skills was successful to differentiate children with Mathematical learning disabilities from below average performing peers and average performers from expert problem solvers. Metacognitive skills are "the regulatory activities associated with solving problems" (Brown, 1978). They involve planning, monitoring, and evaluation components of Metacognition. It is also called

as ‘Regulation of cognition’ which refers to the activities and actions undertaken by individuals to control their own cognition [Cooper, M., & Sandi-Urena, S. (2009)].

There are different methods to assess Metacognition. Self-report questionnaires, hypothetical interviews and stimulated recall, think-aloud protocols and systematical observations are fruitfully being used. In addition in the performance calibration and post-diction paradigm participants are asked after the solution of a Mathematics task, to assess the correctness of the solution. A comparison is made of whether evaluation after a task corresponds with the actual performance on the task.

Mathematics as an important subject in school curricula has its own place in the practical life of every individual. It is very clear that the abilities and skills of Mathematics Education could be improvised so that students of Mathematics will reach heights easily. The more related concepts of Mathematics are Metacognitive skills, Numerical ability, Problem solving ability, Spatial ability, Mathematisation, Comprehending in Mathematical language, Mathematical creativity, etc.,.

The popular and fundamental abilities are Numerical ability and problem solving ability. Numerical ability helps one to understand the concepts of numbers and makes number sensible. Problem solving skill learnt at Primary level leads to the Problem solving ability in secondary and higher classes, which takes lead to all other Mathematical abilities. The other important component in Mathematics Education is creativity. Creativity is the prominent tool that increases imagination, flexibility and helps one to express himself in a fine innovative way. In connection to the Ethnomathematical Teaching, all the related variables which were discussed have a close relation.

The related studies of the above mentioned variables are depicted as follows:

Table no 1.2: Table depicting Researches on Metacognitive Skills, Numerical Ability, Problem Solving Ability and Creativity

Researcher	Year	Title of the study	Results
Amin, I., & Sukestiyarno, Y.L.	2015	Analysis Metacognitive Skills on Learning Mathematics in High School	There Is A Positive Correlation Between Cognitive Skills And Metacognitive Skills With Sufficient Medium
Barbacena, Sy.,	2015	Metacognitive Model in Mathematical Problem Solving	Individual Student Has His/Her Own Pattern Of Solving A Problem.
Lorena Aguelo Java	2014	Problem Solving Strategies and Metacognitive Skills for Gifted Students in Middle School	GEAR strategy does affect the Metacognitive skills of middle school gifted students in problem solving and creates a marginal improvement on their classroom performance
Fatoke, A.O, Et. Al.,	2013	The Effects of Problem-Solving Instructional Strategy and Numerical Ability on Students' Learning Outcomes	Problem-solving instructional strategy as well as students' numerical ability improves performance in chemistry
Githua, B.N., & Njubi, J.N.,	2013	Effects of Practicing Mathematical Creativity Enhancing Learning / Teaching Strategy During Instruction on Secondary School Students' Mathematics Achievement by Gender in Kenya's Nakuru Municipality	MCETS is an effective teaching/learning strategy which Mathematics teachers need to incorporate in their teaching

Annemie	2009	Mathematics and Metacognition in Adolescents and Adults with Learning Disabilities	Many adults had problems with planning and keeping track of steps and that supporting surroundings were important protective factors towards the chances of success
Erdogan, S., & Baran, G.,	2009	A Study on the Effect of Mathematics Teaching Provided Through Drama on the Mathematics Ability of Six-Year-Old Children	A positive effect of Mathematical ability through mathematic teaching based on drama was found.
Noorgahan. N Ganihar & Wajiha,A.H.	2009	Investigated Factors Affecting Academic Achievement on IX Standard Students in Mathematics	Students studying in both aided and unaided schools were high on Achievement in Mathematics, Mathematical creativity and test anxiety when compare to government schools.
Kramarski, B. & Mevarech, Z. R.	2003	Enhancing Mathematical Reasoning in the Classroom: The Effects of Cooperative Learning and Metacognitive Training	The cooperative learning and Metacognitive training group outperformed the individual groups of cooperative learning group and group of students without Metacognitive training
Padmaja, K.	2002	Mathematical Ability in Relation to Mathematical Achievement of VIII Class Pupils in Warangal District	There is high positive Significant relationship (0.63) between the Mathematical ability and Mathematical achievement of the pupils.
Swarnalekha	1997	Studied Joyful Active Learning in Promotion of Problem Solving Ability Among Primary Level Students	It was found important to frame different activities to develop different skills like comprehension, judgment, analysis, synthesis, critical

			thinking, problem understanding, finding analogy, is checking equivalence in similar situations.
Girija Devi Thampuratty, N.R.	1996	Socio economic Status of Creative High Achievers and Creative Low Achievers in Mathematics	The interactive effect of the variables attitude towards Mathematics and sex on Achievement in Mathematics was significant.

It is the need of this era to examine the Ethnomathematical perspective where-in the embeddedness of Mathematics in all cultures takes on the cultural nature of knowledge production into a Mathematics curriculum. It would be more relevant and meaningful for school Mathematics regarding the promotion of the overall quality of students' educational experiences. It is very important to build up connections between Mathematics and real life situations to avoid boredom and create interest in Mathematics among school students. The best way to do so, according to the Researcher seems to be the enrichment of Ethnomathematical Teaching Programmes and applying the Ethnomathematical strategies and methods in the present curriculum. Hence the researcher felt an urgent need to do study on some prominent skill oriented concepts for enhancing creativity in students studying Mathematics.

The researcher's mind is puzzled to enquire about the back log of Mathematics Education. Hence the questions in the Researcher's mind are as follows:

1. What are the obstacles in the achievement of school students in Mathematics Education?
2. What are the obstacles in the back log in qualitative development in Mathematical education?
3. What are the challenges faced by the teachers in teaching Mathematics to School students?
4. What are the possible solutions for resolving the issues and challenges in teaching Mathematics?

5. Are there any possible alternative teaching transactions to improvise teaching Mathematics?
6. Is there any connectivity between Mathematics and the cultural background of the school students?
7. Can teachers of present situation apply the cultural aspects in teaching Mathematics?
8. Will it be an effective alternative teaching method / strategy to create interest in teaching Mathematics?
9. Will it be a helpful tool to increase all Mathematical abilities and foster creativity among school students?

To get answers for the above mentioned questions regarding Mathematics Education and creating some quality and creativity in Mathematics Education in the school environment, the researcher has decided to take up the research study to find the effect of ICT integrated Ethnomathematical Teaching on Metacognitive skills, Numerical ability, Problem solving ability and Creativity.

1.2.0 STATEMENT OF THE PROBLEM

The statement of the problem will be **"Effect of ICT Integrated Ethnomathematical Teaching on Metacognitive Skills, Numerical Ability, Problem Solving Ability and Creativity among Secondary Students"**

1.3.0 OPERATIONAL DEFINITIONS OF THE TERMS

The original and operational definitions of the terms used in the study are as follows:

ICT Integrated

ICT is the combination of informatics technology with other, related technologies, specifically communication technology – UNESCO (2002).

Earle (2002), describes integration as having a sense of completeness or wholeness by which all essential elements of a system are seamlessly combined together to make a whole.

In the present study, the technology based material which could be integrated for the preparation of teaching lesson plans of Mathematics will be considered as ICT integrated material.

EthnoMathematics

"Ethnomathematics is the Mathematics practiced by cultural groups" (D'Ambrosio, 2001)

Furuto (2014), defined Ethnomathematics as "the intersection of culture, historical traditions, sociocultural roots and Mathematics"

In the present study Ethenomathematics will be considered as Mathematical concepts and Mathematical skills which could be observed in the particular ethnic group, generally in practice.

Metacognitive Skills

According to Jacob and Paris (in Schraw & Moshman, 1995), there are three metacognitive skills are essential, namely: planning, monitoring, and evaluation.

In the present study, the students' ability to plan, monitor and evaluate the Mathematical concepts by themselves will be considered as Metacognitive skills.

Numerical Ability

Numeracy is the ability to reason and to apply simple numerical concepts. – Wikipedia

In the present study the students' ability to do solve numerical problems effectively will be considered as numerical ability.

Problem Solving Ability

Polya defined problem solving as finding "a way where no way is known, off-hand… out of a difficulty…around an obstacle" (1949/1980, p. 1).

In the present study, the ability of the students in finding out the solutions for the problems involved in the Mathematics teaching and evaluation will be considered as problem solving ability.

Creativity

Creativity is the generation of imaginative new ideas (Newell and Shaw 1972), involving a radical newness innovation or solution to a problem, and a radical reformulation of problems.

In the present study, the innovative ideas to solve the Mathematical problems, their planning, monitoring and evaluating throughout the teaching process related to their culture will be considered as creativity.

Secondary students

Secondary Education covers children studying from class VI to class X comprising of Lower Secondary and Upper Secondary classes. (NPE 1986)

In the present study the students of class upper primary level will be considered as secondary students.

1.4.0 VARIABLES OF THE STUDY

The different variables of the study will be depicted as follows:

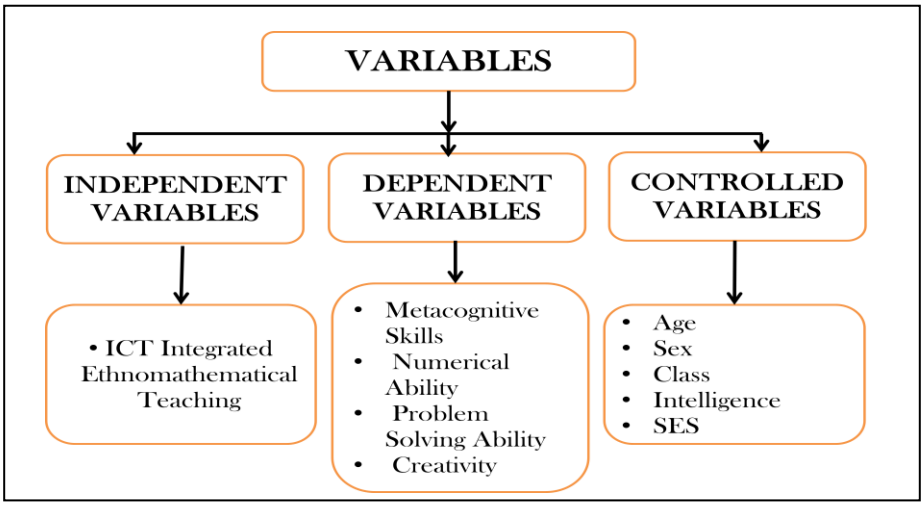

Fig. 1.1: Depicting variable of the study

1.5.0 OBJECTIVES OF THE STUDY

The objectives of the research study will be as mentioned below:

1. To study the effect of ICT integrated Ethnomathematical Teaching on Metacognitive skills of secondary students.
2. To study the effect of ICT integrated Ethnomathematical Teaching on Numerical ability of secondary students.
3. To study the effect of ICT integrated Ethnomathematical Teaching on Problem Solving ability of secondary students.
4. To study the effect of ICT integrated Ethnomathematical Teaching on Creativity of secondary students.
5. To study the interaction effect of ICT integrated Ethnomathematical Teaching on Metacognitive skills, Numerical ability, Problem Solving ability and Creativity of secondary students.
6. To compare the effect of ICT integrated Ethnomathematical Teaching on Metacognitive skills, Numerical ability, Problem Solving ability and Creativity of secondary students of Tamil Nadu and Madhya Pradesh.

1.6.0 HYPOTHESES OF THE STUDY

The hypotheses of the study will be as follows:

Ho1: There will be no significant effect of ICT integrated Ethnomathematical Teaching on Metacognitive skills of secondary students.

Ho2: There will be no significant effect of ICT integrated Ethnomathematical Teaching on Numerical ability of secondary students.

Ho3: There will be no significant effect of ICT integrated Ethnomathematical Teaching on Problem Solving ability of secondary students.

Ho4: There will be no significant effect of ICT integrated Ethnomathematical Teaching on Creativity of secondary students.

Ho5: There will be equal significant effect of ICT integrated Ethnomathematical Teaching on Metacognitive skills, Numerical ability, Problem Solving ability and Creativity of secondary students.

Ho6: There will be equal significant effect of ICT integrated Ethnomathematical teaching on Metacognitive skills, Numerical ability, Problem Solving ability and Creativity of secondary school students of Tamil Nadu and Madhya Pradesh.

1.7.0 METHOD OF THE STUDY

Quasi – experimental design with two groups will be used. One will be the experimental and the other will be the control group.

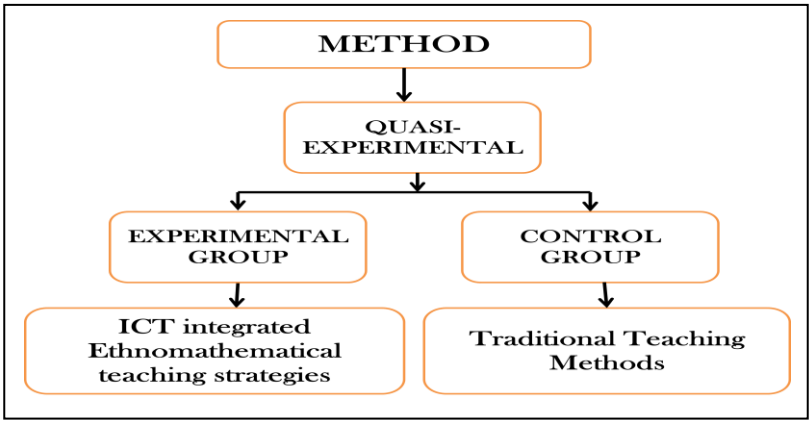

Fig 1.2: Depicting the method of the study

1.8.0 SAMPLING OF THE STUDY

A sample of 120 secondary students will be taken from a two schools of two different states through purposive sampling as the sample should be the true representative of a particular ethnic group.

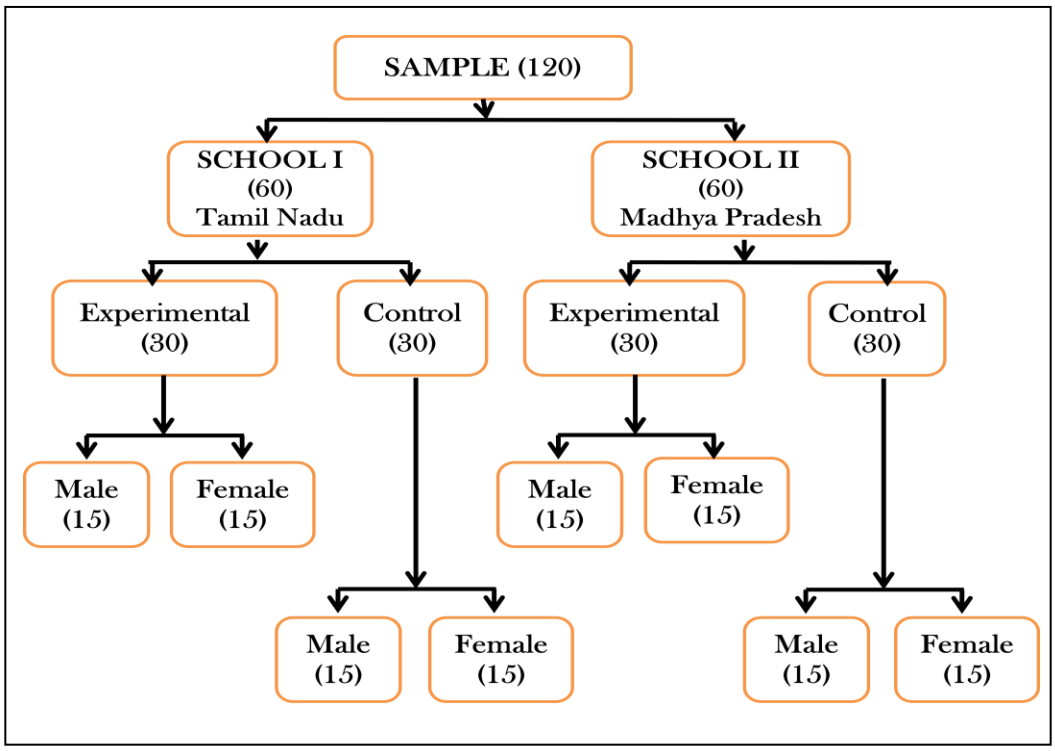

Fig 1.3: Depicting the sample of the study

1.9.0 TOOLS

The following list of tools will be used to in the research study:

1. **Metacognitive skills:** To measure the Metacognitive skills, Metacognitive skill test will be constructed by the researcher by considering the skills of planning, monitoring and evaluating.

2. **Numerical Ability:** To measure the numerical ability of the students, Numerical ability test will be constructed by the researcher.

3. **Problem Solving Ability:** To measure the problem solving ability of the students, Problem solving ability test will be constructed by the researcher.

4. **Creativity:** To measure the creativity of the students, creativity test will be constructed by the researcher.

1.10.0 STATISTICAL TECHNIQUES

To analyze and interpret the data obtained the researcher will use the following statistical techniques:

Descriptive Statistics: Mean, Standard Deviation

Inferential Statistics: t – test, ANOVA

1.11.0 DELIMITATIONS OF THE STUDY

The delimitations of the study will be as follows:

1. ICT integrated Ethnomathematical Teaching on Secondary students only will be considered.

2. Students of two states (i.e) Tamil Nadu and Madhya Pradesh will be considered.

3. Secondary Students only will be considered.

4. Only class VIII students will be considered.

1.12.0 SIGNIFICANCE OF THE STUDY

The research study is very closely associated with present scenario and of great importance of Mathematical education today. The results of this study would be more beneficial to the student community, but also to the teachers, curriculum framers, policy makers, administrators and parents.

1. The students will be highly benefitted because Ethnomathematical Teaching strategies will increase better understanding of the concepts. The more the students understand the

concepts easily, the better they attain knowledge. The cultural background of the students will help them to enjoy the class and makes the class interesting. The practical aspects of the present culture give real life experiences that provide long lasting knowledge. It will also be helpful to the students to express their views in the better way rather than expressing in an alien language. The cultural activities and the native environment helps the students to develop their creativity in Mathematics.

2. For the teachers it would be more helpful in such a way that it will increase the achievement rate of the students, hence can show their better teaching performances. Teachers could be able to use different Ethnic background materials, Ethnomathematical Teaching strategies / methods and techniques to transact the content effectively. Is would be easy for them in the preparation of plans efficiently as it is the native concept. Teachers of other cultural background would be able to help in integrating their culture in the existing culture to promote inter cultural relationships. It also will help them to develop multi cultural pedagogical strategies on the basis of Ethnomathematical Teaching.
3. For the curriculum framers, it will give the overall idea about framing innovative, effective, approachable, value oriented, environment friendly and inclusive curriculum.
4. For the policy makers, it will be beneficial to bring about changes in policies and framing policies according to the cultural environment.
5. For administrators it will be useful in constructing cost effective teaching material.
6. It would also be so beneficial to the parents in guiding their children in doing home work, facilitating couching and correlate the real situations according to their family and community background.

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